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Docket No. AME-T114
Serial No. 10/694,453Amendments to the Claims

Claim 1 (previously presented): An apparatus for the application of coatings in a vacuum, comprising

at least one filtered arc source comprising at least one cathode contained within a cathode chamber,

at least one anode associated with the cathode for generating an arc discharge, a plasma duct in communication with the cathode chamber and with a coating chamber containing a substrate holder for mounting at least one substrate to be coated, the substrate holder being positioned off of an optical axis of the cathode, at least one pair of focusing conductors disposed adjacent to the cathode and the plasma duct, along upstream and downstream sides of the cathode, for focusing a plasma flow from the cathode to the plasma duct,

at least one pair of deflecting conductors disposed adjacent to the downstream side of the cathode and opposite sides of the plasma duct, generating a deflecting magnetic cusp for deflecting a plasma flow from the arc source into the plasma duct and a focusing magnetic field for focusing a plasma flow along the plasma duct, the deflecting field coupling with the focusing magnetic field in the cathode chamber, the at least one pair of focusing conductors comprising conductors generating an upstream magnetic cusp in a direction opposite to the deflecting magnetic cusp and extending into the plasma duct, a plane of symmetry being defined between the upstream cusp and the deflecting magnetic cusp, and

at least one metal vapor or sputter deposition plasma source comprising a material to be evaporated and installed in the plasma duct in a region between the upstream magnetic cusp and the deflecting magnetic cusp, on the side of the plane of symmetry toward the deflecting magnetic cusp or in a region where the deflecting magnetic field is too small to deflect electrons from the at least one plasma source, whereby metal vapor propagates toward the substrate along magnetic field lines of the deflecting magnetic field.

Claims 2-16 (canceled)

Claim 27 (previously presented): The apparatus of claim 1 comprising a pair of deflecting conductors disposed adjacent to an upstream side of the cathode, whereby a downstream flow of plasma is generated from the arc source and deflected toward the plasma duct and an upstream flow of plasma is generated from the arc source and deflected away from the plasma duct.

Claim 28 (currently amended): The apparatus of claim 1 wherein the at least one metal vapor or sputter deposition plasma source is disposed along an optical axis of the substrate holder.

Claim 29 (currently amended): The apparatus of claim 27 wherein the metal vapor or sputter deposition plasma source is disposed in a center of a magnetic cusp created between the downstream deflecting conductors and upstream deflecting conductors, in a region where the magnetic field is generally smallest.

Claim 30 (previously presented): The apparatus of claim 29 comprising an electron beam for evaporating the material.

Claim 31 (currently amended): The apparatus of claim 1 wherein the at least one metal vapor or sputter deposition plasma source is coupled to the cathode or to the anode and disposed in a line of sight with the substrate holder.

Claim 32 (currently amended): The apparatus of claim 31 wherein the at least one metal vapor or sputter deposition plasma source is surrounded by a shield which insulates the at least one metal vapor plasma source from the plasma flow, the shield having an opening to expose material to be evaporated to the plasma flow.

Claim 33 (previously presented): The apparatus of claim 29 wherein an evaporator is disposed between the upstream and downstream plasma flows.

Claim 34 (currently amended): The apparatus of claim 29 wherein an evaporator or sputter deposition source is disposed in the upstream plasma flow and the material evaporates or sputters under the influence of the plasma flow.

Claim 35 (currently amended): The apparatus of claim 34 comprising focusing conductors disposed adjacent to the metal vapor or sputter deposition plasma source and the plasma duct on upstream and downstream sides of the metal vapor plasma source, for focusing a plasma flow from the metal vapor or sputter deposition plasma source to the plasma duct.

Claim 36 (previously presented): The apparatus of claim 1 wherein impulse lasers are positioned to ignite an impulse vacuum arc discharge on a surface of the cathode.

Claim 37 (previously presented): The apparatus of claim 1 comprising a repelling anode parallel to the plasma duct and installed around the plasma duct near the exit of the plasma duct for directing an ion plasma stream toward the at least one substrate.

Claim 38 (previously presented): The apparatus of claim 36 comprising a repelling anode parallel to the plasma duct and installed around the plasma duct adjacent to the exit of the plasma duct.

Claim 39 (previously presented): The apparatus of claim 38 wherein the cathode comprises a non-conductive evaporating material and a power supply is installed between the repelling anode and ground.

Claim 40 (previously presented): The apparatus of claim 37 comprising a repelling anode parallel to the plasma duct and installed around the plasma duct adjacent to the exit of the plasma duct, and a power supply installed between the repelling anode and the cathode.

Claim 41 (currently amended): The apparatus of claim 35, wherein the metal vapor or sputter deposition plasma source is disposed in a plane of symmetry between magnetic cusps of the focusing conductors.

Claim 42 (previously presented): The apparatus of claim 1 wherein the at least one metal vapor plasma source is disposed in a substrate chamber with the substrate holder.

Claim 43 (previously presented): The apparatus of claim 1 wherein the at least one cathode comprises a thermoionic cathode or a hollow cathode.

Claim 44 (previously presented): An apparatus for the application of coatings in a vacuum, comprising

at least one filtered arc source comprising at least one cathode contained within a cathode chamber,

at least one anode associated with the cathode for generating an arc discharge,
a plasma duct in communication with the cathode chamber and with a coating chamber containing a substrate holder for mounting at least one substrate to be coated, the substrate holder being positioned off of an optical axis of the cathode,

at least one pair of focusing conductors disposed adjacent to the cathode and the plasma duct on upstream and downstream sides of the cathode, for focusing a plasma flow from the cathode to the plasma duct,

at least one pair of deflecting conductors disposed adjacent to the cathode and the plasma duct, generating a deflecting magnetic cusp for deflecting a plasma flow from the arc source into the plasma duct and a focusing magnetic field for focusing a

plasma flow along the plasma duct, the deflecting magnetic field coupling with focusing magnetic field of the cathode chamber,
the at least one pair of focusing conductors comprising conductors generating an upstream magnetic cusp in a direction opposite to the deflecting magnetic cusp and extending into the plasma duct, a plane of symmetry being defined between the upstream cusp and the deflecting magnetic cusp, and
at least one metal vapor or sputter deposition plasma source comprising a material to be evaporated, positioned off of an optical axis of the coating chamber and installed in the cathode chamber on the side of the plane of symmetry toward the downstream cusp or in a region of the focusing magnetic field between the upstream magnetic cusp and the deflecting magnetic cusp where the deflecting magnetic field is too small to deflect electrons from the at least one plasma source,
whereby metal vapor propagates toward the substrate along magnetic field lines of the deflecting magnetic field.

Claim 45 (currently amended): The apparatus of claim 44 wherein the at least one metal vapor or sputter deposition plasma source is disposed in the coating chamber in opposition to the filtered arc source.

Claim 46 (previously presented): The apparatus of claim 45 comprising an electron beam for evaporating the material.

Claim 47 (currently amended): The apparatus of claim 44 wherein the at least one metal vapor or sputter deposition plasma source is coupled to the cathode or the anode and disposed off of an optical axis of the substrate holder.

Claim 48 (previously presented): The apparatus of claim 47 wherein the metal vapor plasma source comprises a heated evaporated anode surrounded by a shield which insulates the metal vapor plasma source from the plasma flow, the shield having an opening to expose material to be evaporated to the plasma flow.

Claim 49 (previously presented): The apparatus of claim 47 wherein the metal vapor plasma source comprises a heated evaporated cathode.

Claim 50 (previously presented): The apparatus of claim 47 wherein the metal vapor plasma source comprises a heated evaporated anode.

Claim 51 (previously presented): The apparatus of claim 47 wherein the sputter deposition plasma source comprises a magnetron source.

Claim 52 (previously presented): The apparatus of claim 44 comprising a deflecting anode and a repelling anode for directing an ion plasma stream toward the at least one substrate.

Claim 53 (previously presented): The apparatus of claim 52 comprising at least one power supply installed between the cathode and either the deflecting anode or the repelling anode.

Claim 54 (previously presented): The apparatus of claim 53 comprising at least one grounded deflecting anode.

Claim 55 (previously presented): The apparatus of claim 53 comprising a power supply installed between ground and the repelling anode.

Claim 56 (previously presented): The apparatus of claim 53 wherein impulse lasers are positioned to ignite an impulse vacuum arc discharge on a surface of the cathode.

Claim 57 (previously presented): The apparatus of claim 49 wherein the cathode comprises a non-conductive evaporating material and a power supply is installed between the repelling anode and the cathode.

Claim 58 (previously presented): The apparatus of claim 47 wherein at least one cathode comprises a thermoionic cathode or a hollow cathode.

Claim 59 (currently amended): The apparatus of claim 47 wherein the at least one metal vapor or sputter deposition plasma source is disposed in a substrate chamber with the substrate holder.

Claim 60 (previously presented): A method of coating an article in a coating apparatus comprising at least one filtered arc source comprising at least one cathode contained within a cathode chamber, at least one anode associated with the cathode for generating an arc discharge, a plasma duct in communication with the cathode chamber and with a coating chamber containing a substrate holder for mounting at least one substrate to be coated, the substrate holder being positioned off of an optical axis of the cathode, at least one deflecting conductor disposed adjacent to the plasma source and the plasma duct, for deflecting a plasma flow from the arc source into the plasma duct, and at least one metal vapor or sputter deposition plasma source installed in the plasma duct between an upstream magnetic cusp and a deflecting magnetic cusp, on a side of a plane of symmetry toward the deflecting magnetic cusp or in a region of the focusing magnetic field where the deflecting magnetic field is too small to deflect a electrons from the at least one plasma source, such that metal vapor propagates toward the substrate along magnetic field lines of the deflecting magnetic field, the method comprising the steps of:

- a. generating an arc between the cathodic arc source and the anode to create a plasma of cathodic evaporate,
- b. evaporating or sputtering a material in the metal vapor plasma source or sputter deposition plasma source to generate a metal vapor or sputter flux in the vicinity of the plasma flow,
- c. ionizing the metal vapor generated by metal vapor or sputter source, and

- d. generating the deflecting magnetic cusp for deflecting a flow of the plasma toward the substrate holder, and
- e. generating the upstream magnetic cusp in a direction opposite to the deflecting magnetic cusp and extending into the plasma duct, the plane of symmetry being defined between the upstream cusp and the deflecting magnetic cusp, whereby the flow of plasma mixes with the metal vapor or sputter flux prior to coating the at least one substrate.

Claim 61 (previously presented): The method of claim 60 wherein the metal vapor plasma source or sputter deposition plasma source is disposed in or adjacent to the flow of plasma.

Claim 62 (previously presented): The method of claim 60 including after step c. the step of focusing the metal vapor plasma or sputter plasma prior to deflecting the metal vapor plasma or sputter plasma into the plasma duct.

Claim 63 (currently amended): The method of claim 60 wherein the metal vapor or sputter deposition plasma source is coupled with the cathode or the anode for ionization of the metal vapor.

Claim 64 (previously presented): The method of claim 60 wherein the repelling electrode is installed surrounding the plasma duct adjacent to an exit of plasma duct.

Claim 65 (previously presented): The method of claim 64 including after step d. the step of repelling ions toward the substrate chamber.

Claim 66 (currently amended): A method of coating an article in a coating apparatus comprising at least one filtered arc source comprising at least one cathode contained within a cathode chamber, at least one anode associated with the cathode for generating an arc discharge, a plasma duct in communication with the cathode chamber and with a coating chamber containing a substrate holder

for mounting at least one substrate to be coated, the substrate holder being positioned off of an optical axis of the cathode, at least one deflecting conductor disposed adjacent to a plasma source and the plasma duct, for deflecting a plasma flow from the arc source into the plasma duct, at least one metal vapor or sputter deposition plasma source installed in the cathode chamber off of a line of sight with the coating chamber, at least one pair of focusing conductors disposed adjacent to the metal vapor or sputter deposition source and the plasma duct on upstream and downstream sides of the cathode, for focusing a vapor plasma flow from the metal vapor source to the plasma duct, a focusing magnetic field and the deflecting magnetic field overlapping, the metal vapor or sputter deposition source installed in a region between an upstream magnetic cusp and a deflecting magnetic cusp, on a side of a plane of symmetry toward the deflecting magnetic cusp, such that metal vapor plasma propagates toward the substrate along magnetic field lines of the focusing and deflecting magnetic field, the method comprising the steps of:

- a. generating an arc between the cathodic arc source and the anode to create a plasma of cathodic evaporate,
- b. evaporating or sputtering a material in the metal vapor plasma source or sputter deposition plasma source to generate a metal vapor or sputter flux in the vicinity of the plasma flow,
- c. ionizing the metal vapor generated by metal vapor or sputter source,
- d. generating a focusing magnetic field for focusing a flow of the metal vapor plasma or sputter plasma toward plasma duct,
- e. generating a deflecting magnetic field for deflecting a flow of the cathodic arc plasma and/or metal vapor plasma toward the substrate holder, and
- f. generating the upstream magnetic cusp in a direction opposite to the deflecting magnetic cusp and extending into the plasma duct, the plane of symmetry being defined between the upstream cusp and the deflecting magnetic cusp,

whereby the flow of plasma mixes with the metal vapor plasma or sputter plasma flux prior to coating the at least one substrate.

Claim 67 (currently amended): The method of claim 66 wherein the metal vapor or sputter deposition plasma source is coupled with the cathode or the anode for ionization of the metal vapor.

Claim 68 (previously presented): The method of claim 66 wherein a thermoionic cathode or hollow cathode is activated after step b. for ionization of the metal vapor plasma.

Claim 69 (previously presented): The method of claim 66 wherein the deflecting electrode and/or at least one repelling electrode is installed along the plane of symmetry of the plasma duct.

Claim 70 (previously presented): The method of claim 69 wherein the repelling electrode is installed surrounding the plasma duct near an exit of the plasma duct.

Claim 71 (previously presented): The method of claim 69 including after step e. the step of repelling ions toward the substrate chamber.

Claim 72 (previously presented): The method of claim 70 including after step e. the step of repelling ions toward the substrate chamber.

Claim 73 (previously presented): The apparatus of claim 1 wherein the at least one metal vapor or sputter deposition plasma source is installed in the plasma duct in a region where the deflecting magnetic field is too small to deflect electrons from the at least one plasma source.

Claim 74 (previously presented): The apparatus of claim 44 wherein the at least one metal vapor or sputter deposition plasma source is installed in the plasma duct in a region where the deflecting magnetic field is too small to deflect electrons from the at least one plasma source.

Claim 75 (previously presented): The method of claim 60 wherein the at least one metal vapor or sputter deposition plasma source is installed in the plasma duct in a region where the deflecting magnetic field is too small to deflect electrons from the at least one plasma source.

Claim 76 (previously presented): The method of claim 66 wherein the at least one metal vapor or sputter deposition plasma source is installed in the plasma duct in a region where the deflecting magnetic field is too small to deflect electrons from the at least one plasma source.

Claim 77 (previously presented): The method of claim 66 wherein the apparatus comprises at least one ionized filtered e-beam evaporator contained within a second cathode chamber, at least one pair of focusing conductors disposed on a downstream side of the e-beam evaporator on both sides of the second cathode chamber and at least one pair of focusing conductors disposed on an upstream side of the e-beam evaporator on both sides of cathode chamber comprising, in any order relative to steps d, e and f, the steps of:

- f. activating an e-beam to evaporate a metal in the e-beam evaporator and create a metal vapor, and
- g. generating a cusp in the second cathode chamber to confine the metal vapor and direct the metal vapor toward the coating chamber.

Claim 78 (currently amended): An apparatus for the application of coatings in a vacuum, comprising
at least one first filtered arc source comprising at least one filtered arc cathode or anode contained within a first cathode chamber,
at least one anode associated with the cathode for generating an arc discharge,
at least one second filtered arc source contained within a second cathode chamber,
a plasma duct in communication with the first and second cathode chambers and with
a coating chamber containing a substrate holder for mounting at least one substrate to be coated, the substrate holder being positioned off of an optical axis of each of the first cathode chamber and the second cathode chamber,

at least one pair of focusing conductors disposed adjacent to the filtered arc cathode and to the plasma duct on an upstream side of the cathode chamber, for focusing a plasma flow from the cathode to the plasma duct,

at least one pair of focusing conductors disposed on a downstream side of the second filtered arc source e-beam evaporator on both sides of the second cathode chamber and at least one pair of focusing conductors disposed on an upstream side of the second filtered arc source e-beam evaporator on both sides of cathode chamber,

at least one pair of deflecting conductors disposed adjacent to the cathode and the plasma duct, generating a deflecting magnetic cusp for deflecting a plasma flow from the arc source into the plasma duct and a focusing magnetic field for focusing a plasma flow along the plasma duct, the deflecting magnetic field coupling with focusing magnetic field of the cathode chamber,

the at least one pair of focusing conductors comprising conductors generating an upstream magnetic cusp in a direction opposite to the deflecting magnetic cusp and extending into the plasma duct, a plane of symmetry being defined between the upstream cusp and the deflecting magnetic cusp, and

at least one of the filtered arc sources comprising an ionized filtered arc source and being positioned off of an optical axis of the coating chamber and installed in the cathode chamber on the side of the plane of symmetry toward the downstream cusp or in a region of the focusing magnetic field between the upstream magnetic cusp and the deflecting magnetic cusp where the deflecting magnetic field is too small to deflect electrons from the at least one plasma source, and

at least one pair of focusing conductors disposed adjacent to the at least one ~~metal vapor or sputter deposition plasma~~ ionized filtered arc source and the plasma duct, on upstream and downstream sides of the at least one ~~metal vapor or sputter deposition plasma~~ ionized filtered arc source, for focusing a plasma flow from the ~~metal vapor~~ ionized filtered arc source to the plasma duct,

whereby metal vapor propagates toward the substrate along magnetic field lines of the deflecting

magnetic field, and a cusp generated in the second cathode chamber by the focusing conductors adjacent to the second cathode chamber confines the metal vapour and directs the metal vapour toward the plasma duct.

Claim 79 (currently amended): The apparatus of claim 78 wherein the second filtered arc source e-beam evaporator is disposed in the second cathode chamber in opposition to the filtered arc source in the first cathode chamber.

Claim 80 (previously presented): The apparatus of claim 78 comprising a deflecting anode and a repelling anode for directing an ion plasma stream toward the at least one substrate.

Claim 81 (currently amended): The apparatus of claim 80 wherein the repelling anode divides a metal plasma stream from the second filtered arc source e-beam evaporator and a filtered arc plasma stream from the filtered arc cathode.

Claim 82 (previously presented): An apparatus for the application of coatings in a vacuum, comprising

at least one filtered arc source comprising at least one cathode contained within a cathode chamber,

at least one anode associated with the cathode for generating an arc discharge,

a plasma duct in communication with the cathode chamber and with a coating chamber containing a substrate holder for mounting at least one substrate to be coated, the substrate holder being positioned off of an optical axis of the cathode,

at least one pair of focusing conductors disposed adjacent to the cathode and the plasma duct, along upstream and downstream sides of the cathode, for focusing a plasma flow from the cathode to the plasma duct,

at least one pair of deflecting conductors disposed adjacent to the downstream side of the cathode and opposite sides of the plasma duct, generating a deflecting magnetic

cusps for deflecting a plasma flow from the arc source into the plasma duct and a focusing magnetic field for focusing a plasma flow along the plasma duct, the deflecting field coupling with the focusing magnetic field in the cathode chamber, the at least one pair of focusing conductors comprising conductors generating an upstream magnetic cusp in a direction opposite to the deflecting magnetic cusp and extending into the plasma duct, a plane of symmetry being defined between the upstream cusp and the deflecting magnetic cusp, and at least one metal vapor or sputter deposition plasma source comprising a material to be evaporated and installed in the cathode chamber, and at least one pair of focusing conductors disposed adjacent to at least one metal vapor or sputter deposition plasma source and the plasma duct, on upstream and downstream sides of the at least one metal vapor or sputter deposition plasma source, for focusing a plasma flow from the metal vapor source to the plasma duct between the upstream magnetic cusp and the deflecting magnetic cusp, on the side of the plane of symmetry toward the deflecting magnetic cusp,

whereby metal vapor propagates toward the substrate along magnetic field lines of the deflecting magnetic field.

Claim 83 (previously presented): The apparatus of claim 82 wherein at least one metal vapor plasma source is disposed in the coating chamber in opposition to the filtered arc source.

Claim 84 (previously presented): The apparatus of claim 83 comprising an electron beam for evaporating material in the metal vapor plasma source disposed in the coating chamber.

Claim 85 (previously presented): The apparatus of claim 82 wherein the at least one metal vapor plasma source is coupled to the cathode or the anode and disposed off of an optical axis of the substrate holder.

Claim 86 (previously presented): The apparatus of claim 85 wherein the metal vapor plasma source comprises a heated evaporated anode surrounded by a shield which insulates the metal vapor plasma source from the plasma flow, the shield having an opening to expose material to be evaporated to the plasma flow.

Claim 87 (previously presented): The apparatus of claim 85 wherein the metal vapor plasma source comprises a heated evaporated cathode.

Claim 88 (previously presented): The apparatus of claim 85 wherein the sputter deposition plasma source comprises a magnetron source.

Claim 89 (previously presented): The apparatus of claim 82 comprising a deflecting anode and a repelling anode for directing an ion plasma stream toward the at least one substrate.

Claim 90 (previously presented): The apparatus of claim 89 comprising at least one power supply installed between the cathode and either the deflecting anode or the repelling anode.

Claim 91 (previously presented): The apparatus of claim 90 comprising at least one grounded deflecting anode.

Claim 92 (previously presented): The apparatus of claim 90 comprising a power supply installed between ground and the repelling anode.

Claim 93 (previously presented): The apparatus of claim 85 wherein impulse lasers are positioned to ignite an impulse vacuum arc discharge on a surface of the cathode.

Claim 94 (previously presented): The apparatus of claim 85 wherein the cathode comprises a non-conductive evaporating material and a power supply is installed between the repelling anode and the cathode.

Claim 95 (previously presented): The apparatus of claim 85 wherein at least one cathode comprises a thermoionic cathode or a hollow cathode.

Claim 96 (previously presented): The apparatus of claim 85 wherein the at least one metal vapor plasma source is disposed in a substrate chamber with the substrate holder.

Claim 97 (previously presented): The apparatus of claim 85 wherein the cathode comprises a non-conductive evaporating material and a power supply is installed between the repelling anode and the ground.

Claim 98 (previously presented): The apparatus of claim 89 wherein the cathode comprises a non-conductive evaporating material and a power supply is installed between the repelling anode and the cathode.

Claim 99 (previously presented): The apparatus of claim 78 wherein the first filtered arc source comprises at least one of a thermoionic cathode source, hollow cathode source, magnetron, ionized E-beam or ionized thermal evaporator.

Claim 100 (previously presented): The apparatus of claim 99 wherein the second filtered arc source comprises at least one of a magnetron, ionized E-beam or ionized thermal evaporator.